The Biological Control of the Coconut Moth (*Levuana iridescens* Beth.-Baker) in Fiji—Book Review

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The publication of "The Coconut Moth in Fiji," by Messrs. J. D. Tothill, T. H. C. Taylor and R. W. Paine, is a notable event in the history of biological control of insect pests. It is of interest to entomologists in Hawaii for the reason that they have had personal contact with the entomologists of Fiji for a number of years, and there has been a number of return visits between them. Thus they have come to know one another's problems fairly well.

In 1905, when I first visited Fiji, this moth was confined to a part of the island of Viti Levu, although it had then been known in the island for nearly thirty years. It was then causing the authorities anxiety, and I was consulted by the Governor, and the Superintendent of Agriculture, as to possible remedies. I advised biological control measures, and suggested some of the islands in the Southwest Pacific as the probable home of the moth, and therefore the most likely place to find suitable parasites. I believe Albert Koebele had given similar advice some months earlier. The Governor, who was also a well-known zoologist, appeared interested in the idea, but it was twenty years before the advice was acted upon. It would be interesting to know the various reasons for the long delay. One reason, I feel quite sure, was the attitude of antagonism of most economic entomologists to biological control in 1905, and for some ten or fifteen years after. Except for a small group of entomologists in the United States, a small group in Hawaii and a few individuals in Europe, the whole of the economic entomological world was opposed to this principle of control. In 1910, a leading British economic entomologist told me that I was a fool for wasting my time; that I should do no good, but a lot of harm. Time brought a change, and this entomologist lived to advocate biological control himself, although he never had a proper understanding of the subject.

One of the factors bringing about this change was the economic success attained in the Hawaiian Islands.

It is possible that this coconut pest could have been controlled by artificial means, but the expense would have been greater than the industry could bear.

One of the things that has been brought out in the report is the gregariousness of *Levuana iridescens* Beth.-Baker, but I do not think enough use has been made of this to account for its slow rate of spread, and for some of its most marked characteristics. The larvae, upon hatching from the eggs, do not disperse, but feed together, and only the exhaustion of the food compels them to move to another leaf; even when full-grown they do not seek solitude to pupate, like so many moth larvae, but congregate in masses to such an extent as to lead to the death of many pupae.

The adult has well developed wings and, if endowed with a wanderlust, would soon have spread over Viti Levu, and even to other islands; but it has a strong nostalgia and will not seek new quarters, even to oviposit, but prefers leaves upon which Levuana larvae are feeding. This leads to the enormous Levuana population in small areas, to the destruction of all its food plant and to the great economic loss; it also is accountable for the very slow spread of the insect. This pyschology also played an important part in the control by the introduced Tachinid (*Ptychomyia remota* Ald.), as the percentage of parasitism as a rule, can rise higher in dense than in sparse populations.

We have a somewhat parallel case in Hawaii in *Anomala orientalis* (Waterh.). This beetle spread very slowly, and increased to enormous numbers in the area of infestation. When the Anomala population became very dense it was often decimated by bacteria. The adult is a good flyer and it was a problem to account for its slow spread, as they were taken feeding on several plants. It was soon found that only males, and females that had already oviposited, frequented flowers; it was seldom that a gravid female was taken feeding. Mating takes place as soon as the female matures, and she deposits her eggs in the vicinity. This was an important factor in its control by *Scolia manilae* Ashm., as the parasite did not have to expend much energy in seeking its host. Thus we see a parallelism due to different causes.

Ptychomyia remota is not a native parasite on *Levuana iridescens,* but is attached to other, but allied, genera in Java and Malay States; *Scolia manilae* is also attached to allied species of Anomala in the Philippines, where *A. orientalis* is unknown. These two parasites have perfect control over their hosts in their new habitats. This indicates that it may be possible to use a foreign parasite to control a native insect under certain conditions.

It is fortunate, from a scientific viewpoint, that no other death factor of importance was established along with *Ptychomyia remota,* as it demonstrates once more what a single parasite can achieve under favorable conditions. Tachinids have a wonderful faculty of finding their hosts, and therefore their critical point of parasitism is often high. The Tachinid on our own sugar cane beetle borer finds its hosts, although they are embedded in the stalk of the sugar cane. The fecundity of *Ptychomyia remota* is very much lower than that of *Ceromasia sphenophori* Vill., but then the former places its eggs upon its host, whereas the latter has to deposit them in the runs of the beetle borer larvae, and the Tachinid grubs have to find their host for themselves. The more direct the contact between the host and parasite, the less need for high fecundity.

As *P. remota* has alternate hosts in Fiji it is likely to spread beyond the range of Levuana, and so be on the spot, should Levuana spread. This is the case with *Scolia manilae,* which exists on Adoretus far beyond the present range of Anomala.

The account of Chalcid B and Chalcid A on Artona in Java (p. 240), and the injurious effects the latter has upon the former, recalls the limiting effect the hyperparasite has upon the Dryinidae in Hawaii.

In studying the Levuana work in Fiji, entomologists in Hawaii will find a number of phases of interest, on account of their similarities to those of their own work.

As the three authors spent some time in Hawaii, it is strange that the only reference to the work here is incorrect. They state that the beetle borer (*Rhabdocnemis obscura* [Boisd.]) threatened to destroy the sugar industry in Hawaii, and that its parasite (*Ceromasia sphenophori*) was introduced from Java. This Tachinid parasite is not known in Java, but in Amboina, Ceram and New Guinea, and was introduced from the last-mentioned locality. The

beetle borer has been in Hawaii for over sixty years and the sugar industry expanded in spite of it. It is true that it exacted a heavy toll during all these years, but it never threatened the life of the industry. It was the leafhopper (*Perkinsiella saccharicida* Kirk.) that did this, and *Anomala orientalis* might have ruined some of the most fertile areas of the Islands, if it had not been controlled.

"The Coconut Moth in Fiji" is published in a beautiful manner, the letter press and illustrations being exceedingly good. The Imperial Institute of Entomology must be given the credit for this.

The entomologists in Hawaii, through considerable experience, are well acquainted with the difficulties and dangers of all such work, and they congratulate all those who took part in finding and introducing and establishing *Ptychomyia remota* in Fiji.